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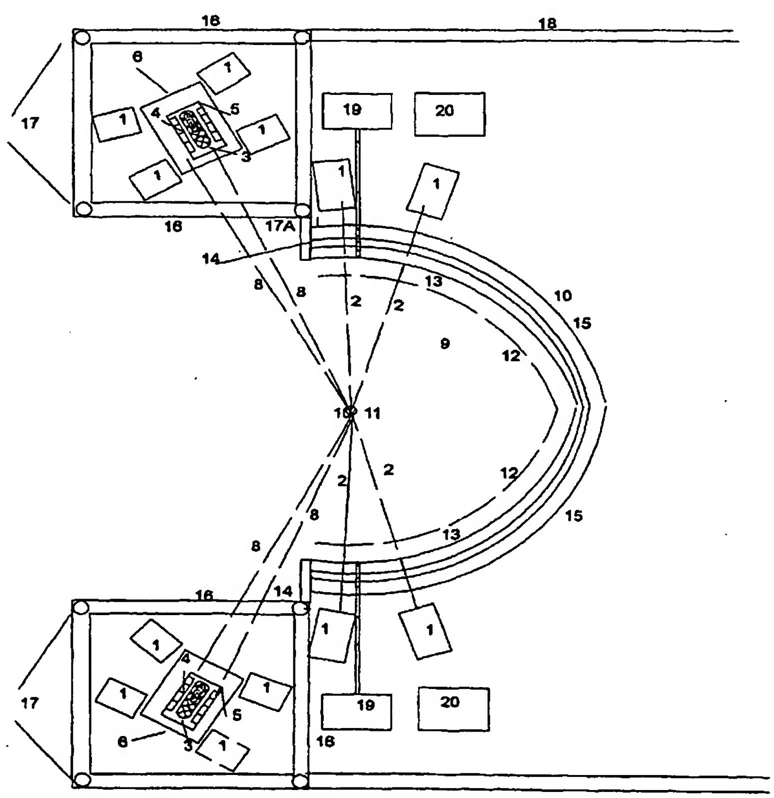
(54) Title: PROPULSION MOTOR



(57) Abstract: A propulsion motor for rockets and spaceships comprises two cylindrical rings (17) linked by means of a bar (18) forming the motor external structure (17,18) and an exhaust (13,14,15) linked to a third cylindrical ring (17A) and to a reactor room (16) where nuclear fuel (3) explodes and generates a beam (8) directed to another nuclear fuel (10) inside the exhaust (13,14,15) which produces thrust a reflector magnetic field (12) avoids that the hot plasma touches the exhaust wall (13). To initiate reactions in the reactor vessel (6) and in the exhaust (13,14,15) an injection system (19) and a production system (20) the fuel (3,10) are needed.

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# PROPULSION MOTOR

The present invention report to an improvement in the motor and processes and from the state of art, relative to an reaction motor whit nuclear fuel, whit purpose to propulsion spaceships, prototypes and rocke ts whit specific impulse $10^5$ sec or more, more than obtained for nuclear fission reaction (only comparable whit micro fusion) or chemical reactions, due to hi-/ gh temperature and high velocity from thermonuclear fusion reactions, the im-/ pulse is greater than DT models due to high ignition temperature in nuclear rea ctions of the present invention fuels, and too be charged particles, how in the / DHe3 reaction, a proton of 14.7 MeV (indeed an neutron of 14.3 MeV) and an alpha particle of 3.6 MeV, or 100% in charged particles. Due to repulsion by / magnetic field of the charged particles, also not permit the hot plasma to touch materials walls that the exhaust is made, to has an idea, tokamaks support 300 millions degree, or the fuel $T_x$ DHe3 to furnish greater impulse in the same pow er by reaction, that is need lower fuel mass by reaction, or millions of degrees / and thousands of km/s also proportioning high thrust (nuclear micro explosio-/ ns) due to high energy density and temperatures. Beyond the beans too being / produced by micro/mini fission or micro fusion reactions, having ignitions (ex-plosions) of this fuel, whit cylindrical or spherical target, or any other process-es of inertial fusion/fission (z-pinch, MTF) to generation micro fusion/fission / and therefore the beam.

The fate to mention a prototype, why is the / more simple object linked to the motor, slowing the mass motor that will be sca led after. Will be a test prototype that will carry reading tool and cameras.

In the before Patent 9303792, the motor is ma-ke up from two cone trunks placed to some distance from another. In the short / cone and around, has many energetic beans fired to target (inside short cone), to

lerate only illumination by indirect drive, due to that configuration. Beyond the target stay restrict to a small area to be fired by the drivers.

In the petition 9715026, like in the technical e xam opposition from this petition, the drivers are internal between exhaust and / motor revestment madding an angle less than 90 degrees in the z-axis (cone wei ght) not forming full direct drive, or corona formation, although some mirrors a re placed in a not specified local, as well as in that opportunity in the technical e xam opposition the novelties was omitted to be write in the claims.

In the Scientific American from jan/99, the mo model is the micro fission fusion in the exhaust, like in the 2/nov/97 Super Interessante, the drive are externs to body motor, fired to the target that is placed inside a half cylindrical bottle, that is a completely different conception. Later in / Internet NASA pages the driver was generalized for inertial fusion in 14/06/01, whit the purpose to initiate an micro fission and after a micro fusion in the exhaust (Advanced propulsion concepts), including VISTA model, whose drivers / are placed behind an parallel to exhaust cone weight and directed by mirrors to nuclear fuels targets, and the reactions take place in the exhaust base short cone, and in the present invention some laser guns are inclined and another are perpen dicular to z-axis and in enough number placed in the exhaust cone tall base, that is, in the opposite side from VISTA model for fast ignition case, whose need co rona formation and in another cases in the present invention, the drive are pla- / ced and generated in a reactor vessel room between the exhaust external motor structure.

The limitation in the nuclear fuel is another / problem, before Patent case, be restricted to a DT and DD making a reasonable neutron quantity, carrying 80% energy, needing hard structures (rising motor / mass whit this fuel and loosing in velocity) to product more fuel or to absorb ne utrons. The DD reaction make tritium, having, therefore DT reactions, yet the /

temperature needed in the ignition of DD reactions is a billion Celsius degrees / and in the DT reactions 100 millions degrees. In the DHe3 reaction are need / 600 millions Celsius degrees and in the $T_x$DHe3, 300/400 millions degrees.

Therefore in the VISTA model the fuel is DT.

In the petition 9715026 the fuel is DHe3, and / in the micro fission fusion is Uranium and DHe3 (ICAN-I).

In the ICAN-II was generalized to DT and DH-e3 initiated by micro fission in 14/06/01.

Another problem whit the proposed fuel is the / stored quantity for the motor mainly for interstellar travel, and in theVISTA ca-se are 4000MT.

Another problem is that energetic beans propo-/ sed in the Patent 9303792 not was specified to initiate second generation nucle-ar fusion fuels (neutron free or low neutron concentration to initiate nuclear fusi on reactions) needing more powerful beans configuring how conventional bea-/ ns or only get the compression or corona formation, although use advanced fu-/ els be rarity, but this is solved.

In the petition 9715026 the driver was mention-ed but not specified, and in technical exam opposition was omitted.

The driver in the VISTA model are, beans of / conventional laser, without mention to another nuclear fuel or another energetic beam.

In the micro fission fusion the driver are beans / of antimatter or antiparticles (ICAN-I), generalized to present laser and particle/ beans in 14/06/01 (ICAN-II) to initiate micro fission and after DT and DHe3 fu-sion reactions inside the exhaust, where we can look is another conception.

Another problem is the exhaust vessel elaborati-on where in the before Patent due to nuclear fusion fuels, need many shields (5)

to protect magnets, to breed tritium for made news fuels. In the DD reaction wh ere the specific impulse is the best, but only DT not furnish enough temperature to ignite DD without He3, that no mention in that document.

In the petition 9715026 the shield modification/ is mentioned but not specified that can be noted change according the fuel to be used. In the present invention the shield change to lowering motor mass that to / near travel made difference but to interstellar travel no much.

As well as, in the VISTA model that is at DT / but not use the producer shield since carry your own fuel, second that model a-re 4000MT of fuel, are preferable the producer shield or a reaction vessel if the case to produce as much fuel whatever the x-ray or gamma ray mean drive, how is in the present invention.

In the micro fission fusion (ICAN-II) due to ex-haust configuration, how can support 600 millions degrees without magnetic fi-eld, that is to avoid this hot plasma to arrive the exhaust material constitution if so, the tokamaks not need magnetic field, moreover in the motor that in some / cases the explosions has 20 ton TNT or more, or the exhaust vessel may be very large, for the radiation don't touch the wall.

Another problem is that present drivers after 9 / years from before Patent not yet begin the ignition and combustion. The present invention show, how to obtain beans whit enough intensity without wait by be-/ fore mentioned drivers, and in an simple manner can test the system at any time whit micro fission or mini fission (can be obtained at any time) and the fusion, / agreed description ahead, where in some cases, many beans can be generated at time. The novelty beam of present invention can be used in ICF reactors to ener gy production.

Already in the Microfusion, indeed detonation / like in Orion project explosions nearly kt intensity, explosions nearly ton TNT

where the fuel is $U_{235}$/DT composite, in some low quantities, but low quantities not so useful for propulsion and military explosions, but good to make the be-/ am. The advantage from present invention is that explosions take place in a rea ctor room vessel madding the beam that will fire only fusion in the exhaust gi-/ ving greater specific impulse than fission initiated, scaling the present invention to advanced fuels in the exhaust. Beyond the storage mass needed even in a tra-ck near the frontier of our Solar system is 50 times greater than needed to make the beans being a problem store so many radioactive material, and the exhaust / will need heavy shield due to neutrons since 1 ton TNT the neutrons are lethal / to 100 m.

The Vasimir project and the gas dynamic mirr-or (GDM), that consist to made and inject a plasma (fusion or not) that is retai-ned in a cylindrical vessel by magnetic fields, where this plasma is heated by ra diation in the Ghertz generated by antenna, was projected to initially work at / hydrogen plasma and not fusion, what will happen after get fusion and your ve locity is near 30 km/s.

Therefore the purpose from the present inventi-on consist in obtain a solution for the above mentioned problems. The chirped / pulse amplification (CPA) has the merit to change present laser beans from kJ in laser pulse nearly $10^{20}$w/cm$^2$ or more but has another lasers and particle be-/ ans in this intensity, being actually possible whit this, initiate a nuclear micro re actions in the reactor or vessel of contention (and not in the exhaust) cited in the present invention, or even neutron beans generated by laser to initiate an micro fission in the reactor room or reaction room.

According to micro explosion intensity not is us eful to propulsion, therefore today make nuclear fusion in ICF, but in the MJ / and without get ignition or target combustion. Some inertial fusion processes li ke z-pinch and MTF are adequate to make radiation energy, where the reactio-/

ns happen in a billionth second duration (same time that take radiation to reach the cylinder in Centurion/Halite project), without has, therefore, fuel ignition or without chain reaction however produce enough energy in due form of x-ray / and gamma-ray that are more piercing and useful to direct drive, that is one of / the conceptions used in the beans elaboration proposed in the present invention madding some adaptation in the fuel. In this technique searching a fuel micro / explosion whit conventional ICF method or not (or with chemical high explosi-ves) from micro fission and micro fusion in aid the energy production in radia-/ tion form, what is more simple to get, because in a nuclear explosion the radiati on travel at light speed reaching the cylinder placed near nuclear micro/mini ex plosion, before any other hydrodynamic phenomena and in a reactor placed out of exhaust to generation the beam that will be directed to the target inside the / exhaust vessel. In another case (0,1g $P_U$ ) detonation whit chain reaction, that / can be retained in a steel or carbon composite vessel (3,5m in diameter) inside and lead out, since whit 1 ton TNT the neutrons are lethal at 100m, and set so / many cylinder are need (the minimal possible due to specific impulse) to beam formation directed to the target inside the exhaust, or using mirrors to direction that beans to a fission/fusion reactor, like z-pinch RTL to breed tritium, inside / the spaceship with the energy purpose and the elements need to another beans, what is an advantage and a novelty.

To deliver the target and made possible an atua-lization of the two illumination type (direct/indirect drive) and several beans / and fuels, that is advanced fuels whit low tritium percentage constitution, or ca-talyzed by tritium, or only pure advanced fuels. Target position can vary from / cone center to exhaust tall base cone and the exhaust cone ray too in models wh it advanced fuels or that need greater energy from micro explosions.

For whit this obtain reactions initiated by DT, / and how mean fuel DHe3, whit fast ignition concept what must last a long time

in present experiments or use the direct drive illumination since a petawat laser (PWL) directed by direct drive to a DT target, only will to expel the electrons / of the fuels material without accomplish its finality, therefore need the corona / for laser matter interaction or change target constitution and the beam. Where is need two drivers, one to corona formation (LIF, HIF, laser) and a high power la ser to inject a hot spot ignition (fission/fusion in cylindrical/spherical target be-am, micro Centurion/Halite, future high power laser) the drivers position is in-/ side, between external revetment and the exhaust cone, therefore this configura-tion require more mass in the beam, but less than in conventional ICF.

By indirect drive, not need corona formation, only need a powerful driver to bath the holhraum and x-ray generation or the / / proposed beans were directed to the target, whit change in target constitution.

The next generation drivers has tendency to be / compact and powerful, and whit one or two sided illumination obtain primary / fuel fusion, and since the mean fuel, the catalyzed and advanced, the present in-vention proposed beans that in some case be placed in front of exhaust short ba-se cone, or in opposite side to exhaust tall base, lowering the extra mass of the / laser/particle gun by indirect drive, or by direct drive whit target to x-ray gam-/ ma-ray absorption.

To make the energetic beans that will possible / pure advanced fuels can mount an inertial fusion/fission reactor to generation / the beam and obtain an variety of intensities scaling whit mass used in each mi-cro explosion in reactor and the cylinder used to simulate the x ray, gamma ray laser, like in Centurion/Halite, in this case, can be placed in the exhaust tall ba se cone and out of external revetment from exhaust, whit this, can change the / intensity from reactor micro/mini explosions whit the purpose to obtain more / powerful beans, because in a x ray laser so much intense will be the source pum ping greater will be the laser intensity, or is proportional to intensity of detonati

on, by one's turn is limited to mass in the detonation due to specific impulse. / Comparatively, being possible the detonation of 1kg $P_U$ initiated by laser and / magnetic fields or chemical high explosives, in this case the velocity is near 26 km/s due to specific impulse, the same order of magnitude from z-pinch LMTL second the following equation (1):

$$v_{ex}= \sqrt{2E_{PN}/m} \quad (1)$$

where $v_{ex}$= exhaust velocity(km/s); $E_{PN}$ = energy production in each nuclear re-action (GJ); m= fuel target mass (kg). In this case the expended mass in the be-/am generation by any processes (cylinder mass used to beam generation + fuel / mass to beam generation + fuel mass used in the exhaust).

The laser and particle beans can be changed / in some places in the reactor room or vessel of contention where the beam is ge nerated and in the terminal part by mirrors directed to the nuclear fuel target in the reactor to generate the beam, lowering the mass in the reaction room due to laser guns.

The energetic beam system in some cases, for / fast ignition concept, where first use a low power beam (conventional particle / beans and laser) only to corona formation and after a high power laser (fission / fusion x-ray/gamma-ray laser, or x ray beans by nuclear pumping) to heat the fu el to ignition conditions, beyond to introduce low tritium proportion in the cons titution in the exhaust nuclear fuel ($T_xDHe3$) that has low temperature ignition / than DHe3 and having low neutron production needing less dense shield, or DT madding a wafer type to insert DHe3, and when the system will optimized use / metallic hydrogen in the DT micro spheres constitution for detonation DHe3 in-serted in the micro spheres, or a greater deuterium proportion to initiate DD rea ctions that need high temperature from DHe3 reactions.

When the energetic beans to be used is the fissi on/fusion whit cylindrical or spherical target directly or by a reactor, can get ad

vanced fuel ignition without need low tritium proportion, but need some symm etry in the beam impact in the fuel target (spherical/cylindrical) due to direct/in direct drive. How are energetic beans and conceived from a singular reactor, / placed in the interior between exhaust cone and internal revetment and in the exhaust tall base cone. Varying mean beam intensity according to reactor fuel / mass, or in the case where don't need very intense micro explosions or in the / case of single HIF beam directed against a cylindrical $DT_xHe3$ target, the dri-/ ver system is placed in the exhaust short base cone. Due to reduced number of guns needed whit this beans reduce the mass motor too, since whit fission ex-/ plosions less than 5 ton TNT is more practical than a fusion micro explosion, to beam generation. An example is detonation of 10g/50g from $P_U$ by chemical hi gh explosive that is more compact than any other method, and more cheap. On-e possibility is across cylindrical millimeter chemical explosive lenses initiated by laser or conventional detonators, depending in the type of lenses, and the mi llimeter/centimeter cylinder distributed around the Pu/U sphere, that generated blast waves madding a symmetrically compression, like in classical lenses bom bs. The modern low yield thermonuclear explosions has been substantially mi-/ croed from football sized pack back to gum, or grapefruit size in SADM confi-/ guration, like a micro nuke bomb, but an English site made an allusion of series of lenses in a bi-conical shape, composite of classical nuclear material, but this can be developed not for war but for the purpose of the present invention. Like is a reactor will has to retain fission/fusion explosions and radiation to produce a energetic beam and than is directed to the target in the exhaust, not raising the mass because in all before mentioned documents the reactor and the beam are / same thing or the external beans are directed to the target inside the exhaust ma dding this set the reactor.

The motive by which are find fission reactions / less than 10 ton TNT is that the order of magnitude, need to initiate fission reac

tions in this scale is in the kJ, that can be verified is the same order of magnitude from liberated energy composite B type explosives, or with very less quantities from chemical explosives being possible with present lasers (micro mini / chemical explosive lenses initiated by laser, generating blast waves in many po ints of a sphere) but difficult to compress such mass, however in fusion the la-/ ser energy is near 2MJ that is present drive state of art. The micro fission can be initiated by laser, mini fission is actually not far this beyond fission can be mo-/ deled the explosions and the explosions result (radiation, blast, heat,etc) and the mini fission can be obtained with few mass (W 54 light detonation) or less, or / light variations of SADM. Or through present invention with laser, particles be ans and magnetic fields, will see ahead.

But the plutonium choice is due to critical state be obtained with less mass quantity than uranium. But the need of plutonium is high 1/4kg for each laser shoot, without chemical explosive needed in the detonation, or if was possible initiate with laser or particles beans and with magne-/ tic field compression, even so will has velocity near 26km/s, since z-pinch LM-TL for propulsion need 80kg and will has 30km/s with an explosion near 1kt.

Another solution with the proposed method is / obtain the beam across micro inertial fusion reactor, lowering considerably the order of magnitude from matter needed for mean drive elaboration across a target of low temperature ignition (high density), once the order of magnitude in / driver intensity is ten kJ, lowering beam intensity in a cylindrical target how is proposed, concentrating the energy in a cylindrical axis than a sphere. Being the computer simulation confirmed this method will be one of more practice. How / has emphasized this is important due to specific impulse. Micro fission needs / drivers from greater order of magnitude than micro fusion, but more easy to get in some cases. With fission can diminish the nuclear fuel mass without loose de tonation intensity.

The plutonium ignition temperature is near / 1keV since is DT 5keV, and DHe3 30keV. Comparatively 1,23g of plutonium / with ray 0,004cm, the driver energy to initiate the reaction is 10/24 MJ and pro duce $4,1.10^{17}$erg, therefore in a plutonium sphere with ray of 5cm will be need / laser in the kJ, since the energy in the B composite is near 5kJ for each kg, bei-ng need 110kg giving 550kJ, but difficult to compress such mass with present drivers and the plutonium produce in this reaction $2,4.10^{18}$erg one order of ma gnitude more than micro fission generating thermal x ray radiation in the ex-/ plosion near 10GJ enough to made x-ray and gamma-ray laser in this intensity and initiate fusion reactions inside the exhaust and 3kg of plutonium produce / 0,004kt, i.e. $1,6.10^{18}$erg in some conditions, or W54 variation weighting near / 16kg and produce 10 ton TNT. However with 0,1g from plutonium (with DT / mass variation in the plutonium center), the driver order of magnitude is 1MJ / (promptly obtained) with the help of magnetic compression or magnetic isola-/ tion, can reduce yet more the incident driver energy, but with enough producti on generating without DT in the fission mass 1.7 ton of TNT to generation the proposed energy driver and raising fuel pressure and density the critical mass / fall with the fuel mass lowering beam intensity needed, or the critically fall wi-th fission mass. Lowering the $P_U$ mass to 0,01g with or without Be reflector fal ling the energy needed in the beam to 100kJ and produce 0,17 ton TNT, i.e. 714 MJ and 10% fuel burn 71,4 MJ. Like in a nuclear explosion 50% is in x radiati-/ on, having the beam intensity near 36 MJ, 20 times all NIF beans. The objective is not made a nuclear artifact, but this analysis show that the objective is to obta in a ignition (detonation) in enough size where x-ray or gamma-ray from such / micro explosions come vaporize a cylinder with x ray transparence material (lo-w Z material) in the cylinder extremity madding the laser, where the following / table 1 show the minimal $P_U$/U mass values to make the beam and enough inten sities for nuclear fuel ignition scaling explosion if need according with intensity

need.

| Fuel mass(g) | yield(ton TNT) | 10% burn(ton TNT) | Equiv. (J) | Diam. Expl. | Driv. Eng. |
|---|---|---|---|---|---|
| 0,001 | $1,76.10^{-2}$ | $1,76.10^{-3}$ | 7,4MJ | 0,42m | 10kJ |
| 0,01 | 0,176 | $1,76.10^{-2}$ | 74MJ | 0,92m | 100kJ |
| 0,1 | 1,76 | 0,176 | 740MJ | 1,97m | 1MJ |
| 1,0 | 17,6 | 1,76 | 7,4GJ | 3,50m | 10/20MJ |

With this analysis arrive at proposed driver, initiated by micro fission fusion, that consist of cylindrical tube make up of gold, a luminum, or tantalum in one side fulfilled with 0,1/0,2g from uranium plutoni-/ um with DT mass 1 μg in plutonium center. In this technique it can use solid or hollow cylinders bombarded with particles beans by direct drive. With particles beans the model that give greater pressure and temperature is the hollow cylinder configuration and the beam with annular spot (hollow beam) and with the sa me cylinder fuel ray being symmetrically heated by incident circular beam and / made the plasma compression in the cylinder axis that can be inject a fast ignition energy through a gold cone perpendicularly directed to this axis. With laser / by direct drive are possible explosive shock waves with solid cylinders target / and the laser beam directed to the cylinder axis. Being gold the cylinder material and using the PWL and due to its intensity many nuclear processes happen / when it shock with the solid material and due to material type some processes / manifest more than others. For DT compression are need two shields, one of / gold where the PWL expel the electrons and this shocking with aluminum produce x-rays that heat DT at the ignition point. $P_U$ compression only need gold / shell for to be reached by PWL producing neutrons, anti-matter, etc in this nu-/ clear processes that arriving the $P_U$ shield join with the shock wave made by laser impact with Au shell make the fission of $P_U$. The evolution to fast ignition is adapting a gold cone (better spot at 30°) to attain the region of compressed plasma with fast coronal ignition method (FCI), where the ignitor beam cone can be in the Pu/U shell and the compression is made in DT shell, or the ignition beam

cone in the DT shell and the compression in Pu/U shell in cylindrical or spheri-/ cal geometry. The most adequate is the compression of $P_U$/U generating neutro-ns and heating DT shell and after to ignitor cone, beyond the target normally us ed in ICF search that has tamper, pusher and the cylinder rod that made the las-/ ser launched separately of the fuel target in the reactor. Where an idea with CP-A laser in USA is to make an ion accelerator. The above idea from present inve ntion is simulate in another scale the Centurion/Halite project, indeed a kt nucle ar explosion a micro fission where the high intensity radiation from this explosi ons in a small time made the laser pumping at arrive a cylinder rod from alumi-/ num or another high Z material and the cylinder is positioned directed to the ex-haust target.

By indirect drive with both consist in holhraum variations with fast coronal ignition (FCI) but in this case the laser are more ef-ficient to heat the holhraum. Then according with target type the cylinder that / make the mean laser is launched separately in the reactor from the fuel target.

Another method is to profit the fission facility / to diminish mass and with this use 0,001g of plutonium/uranium (and μg from DT inside this $P_U$/U shield mass) needing in the beans near 10kJ to initiate $P_U$/U micro explosions and after DT, the x or γ radiation reach the cylinder vaporizi-/ ng it, having transparence lenses to x or γ radiation madding this manner the la-ser, in this case the cylinder is mounted in a capsule around the target, i.e. the / target and the cylinder are one thing. Or injecting as well as cylinder whatever the fuel separately across wall orifices in different places not needing the capsu le, but is the same principle. Like is a metal your trajectory can be scanned by laser and computer calculations and positioned by magnetic field.

The advantage from this system that are micro / explosions that will be retained in a short cylinder from 42 cm in diameter, sin-ce explosions diameters are proportional to cubic root explosion intensity, follo

wing equation (2):

$$d=0.32\sqrt[3]{E_{PN}} \quad (2)$$

where $E_{PN}$(kg TNT) is the nuclear yield, generating the laser with an axial magnetic field in the cylinder bring in to action moments before implosion (beyond to avoid loss fuel entropy) and retaining the energy in the cylinder, obeying the condition BR>10 Tm, that is possible with present magnetic fields (not z-pinched, but this is possible with z-pinch fields and combination, that is an axial on-/ ly, or axial and radial magnetic fields). In the case of axial magnetic field, the in cident driver is a single particle beam (HIF) with your circular symmetry that ar rive the cylinder fuel shield under the tamper in the reactor target. In another / two cases, the incident driver is the conventional ICF methods with a radial (or mix) magnetic field. Due to small size dimensions in radial magnetic field the e nergy needed in the magnet can be obtained by storage capacitors that fire in / short time the energy to the magnet that are of or explode after a time, generati ng very high compression needed in micro fission reactions, like in wire array / z-pinch. The magneto in ambient temperature and for axial field are madding of cooper wire strengthened by fine filaments of aluminum, silver or niobium with support from fiber glass or carbon composite generating magnetic fields near 70 T in pulsed regime, since pure cooper not support the strong stress that the magnetic field applies to the magnetic, beyond how strong wire diameter less capaci ty, or without magnetic field, since in this mass scale fission the driver is promp tly obtained (ICF or chemical high explosive methods), since this field is used / where mass fission raise and need more energy in the driver to initiate micro fis sion. The advantage of magnetic fields is avoid loss of energy needing less are al density and energy in the beam. This has advantage on the z-pinch since the / repetition rate is high, therefore in conventional z-pinch is low (only good to fe ed an laser with high repetition rate like proposed in present invention) althou-/ gh produce actually 2MJ of x-radiation, more than 1.8 MJ from NIF and with /

upgrade to 16MJ in the x-ray driver energy, or in the fast z-pinch, where the z-pinch adapted to fast ignition is used to detonation inside the exhaust the fuel. / The difference, the present invention made a x-ray laser, the z-pinch systems / made a x-radiation or the z-pinch plasma is launched in the exhaust, beyond in the present invention the x-radiation or x-ray laser radiation is used to make a / mean driver in a reaction vessel for after initiate inside the exhaust the nuclear / micro fusion of advanced fuels or not and has more efficiency than in the micro fission fusion (ICAN-I) that has a relatively powerful and expensive driver to / made the same thing, therefore after driver generalization (ICAN-II), to initiate a micro fission followed by fusion, but detonation the fuel inside the exhaust.

Or only fission, since the order of magnitude in the driver energy to generate 10/100MJ is very below from generated energy in the processes. However the neutrons from $DT_x$ reactions in the plutonium cen ter increase the fission reactions simulating in a lesser scale the Centurion/Hali te project, having the fuel a cylindrical or ellipsoidal shape.

In the less explosive case, the reactor localiza-tion is one in each side of the exhaust tall base cone, internal, between the revet ment and the exhaust. In this case the more practical is initiate a low quantities/ of Pu/U (mg/g) by chemical explosive lenses (with 0,5 mg of silver azide were obtained cylindrical blast waves) initiated by laser. With the help of nanotech-/ nology in the improvement of high explosives (and raising the chemical mass / of high explosive and nuclear explosive in the same proportion) in 1 order of / magnitude according the following calculation, known that 0,1g U is need 100 kJ in the driver and the energy density of high explosive 6kJ/g calculating the / volume the ratio is two orders of magnitude assuming 100% coupling. In fusi-/ on with the same calculation the volume of chemical explosive is 5 orders of / magnitude greater. With this will need 1 to 10g of high explosive for detonati-on 0,1g of U being viable the better practical and cheap system to initiate a mi-

cro mini fission explosion to made the beam and in this case the reactor is only the contention vessel. The high chemical explosives haven't velocity and energy to initiate a pure fusion but is adequate to begin a micro mini fission from the same order of magnitude from high explosive mass, with fission detonati-/ ons less than 1 ton TNT to make the beam.

When in a more explosive reactions, the place / of reactor is out of motor revetment, or madding of a 3 vessel system where 2 / of them are placed in opposite side from exhaust tall base cone, generating the / laser beam directed to the target inside the exhaust, or directed to another reac-/ tor inside the spaceship. The reactor is able to support micro mini fission reacti ons. Comparatively 1.7 ton TNT is possible to be retained in a modest steel ves sel, and in the present invention due to magnets is need a lead shield to retain / the neutrons or carbon-carbon composite having high heat resistance or graphite or a HYLIF configuration to retain the explosions. This conception has advantages upon micro fission fusion (ICAN I/II, micro fusion), the exhaust are free of neutrons from fission, lightening the shields for neutrons free fuels, bey-/ ond to proportion a better conception about the reactor or reaction vessel of con tention that will generate the driver and how to retain neutrons and being better to manipulate than in the exhaust.

With nuclear fusion reactions raising the micro spheres mass from exhaust lower the driver intensity, what can be obtained by / fast ignition methods or by indirect drive with present drivers. Comparatively in mini fusion to initiate a reaction are used explosive plastic lenses, madding an / artifact of 10 kg called "baseball bomb" madding near 1 ton TNT. The specific impulse yet is low being the mass limit 1 kg. Using the present invention meth-/ od initiating by laser, particles beans, etc. and with the help of magnetic field, / we can low the matter quantity used in the nuclear driver elaboration from milli grams to micrograms, since 1 mg of DT produce 334 MJ with 10% of burn pro-

duce 33,4 MJ and 50% (x-ray/γ-ray) 16,7 MJ in x-radiation or gamma radiation, that is 10 times more the energy introduced by laser in the NIF, and 5 times mo re the production of 1 mg of U, agreed see above. This reduce, the mass needed to make fuel, with two reactors in each side for 70 kg/yr that is reasonable for / deep interplanetary voyager, and the specific impulse depend approximately of the exhaust fuel.

| Model | Driver mass | Exhaust mass | burn % | Cylind. Mass | $I_{sp}$ | v |
|---|---|---|---|---|---|---|
| Vasimir (GDM) | - | ? | | - | 4000 | 30 km/s |
| Z-pinch LMTL | - | 80 kg | | - | 4000 | 30 km/s |
| Pres. Invention | 1 kg | 1 g | 100 | $4x10^{-3}$g | 2617 | 26 km/s |
| Idem | 1 g | 1 g | 100 | $4x10^{-3}$g | 88399 | 817 km/s |
| Idem | 1 g | 1 g | 50 | $4x10^{-3}$g | 58972 | 573 km/s |
| Idem | 1 g | 1 g | 10 | $4x10^{-3}$g | 26373 | 258 km/s |
| Idem | 1 g | 1 g | 1 | $4x10^{-3}$g | 8399 | 82 km/s |
| Idem | 0,01g | $5x10^{-3}$g | 100 | $4x10^{-3}$g | 83399 | 817 km/s |
| Idem | 0,01g | $5x10^{-3}$g | 50 | $4x10^{-3}$g | 58972 | 573 km/s |
| Idem | 0,01g | $5x10^{-3}$g | 10 | $4x10^{-3}$g | 26373 | 258 km/s |
| Idem | 0,01g | $5x10^{-3}$g | 1 | $4x10^{-3}$g | 8399 | 82 km/s |
| Idem | $1x10^{-4}$(Fus.) | $50x10^{-3}$g | | $4x10^{-3}$g | 81004 | 793 km/s |
| Ideal case | 0 | $50x10^{-3}$g | 100 | 0 | 83398 | 817 km/s |

Table 2 has how reference the energy produ-ced by DT and mass of U235 and DT, for DHe3 is the same data but with less fuel mass; burn % = percent of nuclear fuel burn in each case, and the classify-/ cation made in internet NASA pages where say that great part of the present pro jects about fusion, anti-matter, and fission, are not proved technologies. Second mine way of think, that can to go on rapidly to next step, or proved technologi-/ es, are z- pinch LMTL, Vasimir/GDM, microfusion, and the present invention, since some comparative data. To give an idea, the energy production need in mi cro explosion is 144 GJ for a velocity of 30 km/s and a waste mass of 80 kg in / the processes and a corresponding fuel mass of 1g of DT and 50% of fuel burn / in the z- pinch LMTL according equation (1). In the present invention with 5-/

mg of DT and 1% of fuel burn the velocity is 82 km/s, the mass consumed by / second is 200 times less, and with 30% of fuel burn the velocity is 500 km/s wi th the same amount of mass (5mg) that is feasible. Yet in micro fusion (new O-rion project) has comparatively the same values from present invention, but as while it go raising the yield and using advanced fuels the fusion reactions has / great specific impulse, or with advanced fuels the mass to made the same thing is near μg. The contrary in microfusion, since to have great DT yield is need gre at amount of Pu/U, beyond be more clean of nuclear fission defects in the exha-ust and better to control in the reactor or reaction vessel.

For increase velocity is need many units accopl-ed to the ship, yet is far from 0,1c, or are need 60 units of 5mg burning 30%, / the same analysis for DHe3 but with less nuclear fuel mass, enlarging the trave-led distance with the same amount of mass stored, or DD reactions initiated by / He3 reactions that has specific impulse of 1.8 times more than DHe3 reactions / second following equation (3), but aren't neutron free.

$$I_{sp}=\sqrt{(1/g)(2\gamma/\gamma\text{-}1)(R/M)T} \quad (3)$$

Where, R, g and T in S.I. units. The advantage / in use neutron free nuclear fuels like DHe3, He3-Li6, D-Li6, initiated or not by tritium in propulsion case, where this nuclear reaction are that has charged parti cles in the products of this reactions and are neutron free and being well choose will proportion a chain reaction free of neutrons, making only charged particles, aiding the thrust. With this it will can to remove the weighted neutron shield, / but in every one of this reaction has chain reactions, since some reactions produ ce neutrons in their reactions and can happen with same probability needing ne-utron shield but less tick. The production shield can be removed, since the ele-/ ments can be efficiently produced in another place beginning fusion or fission / reactions that produce this element, remaining in this case, the first wall, the pro tector shield and the magnetic field. Or in the case of DHe3 without be catalyz-/

ed the fuel of analogous configurations write bellow is detonated by the propo-/ sed driver, needing the first wall and the magnetic field, where the material ne-/ ed to the fuel is produced in the reactor(s) together with the mean driver, that is the dry system with present technique that can support advanced fuels without / extreme risk.

In the reaction DT-DHe3-DD, or the DT reacti- on initiate DHe3 reaction that produce enough temperature to initiate DD reacti on, that has the better specific impulse to have better ignition temperature.

In this case, not needing the production shield / in the motor, want to have a means to produce D and He3 that can be obtained / by laboratory fusion reactions inside the spaceship, therefore producing tritium that decay in 12 years in He3 therefore producing deuterium if the case.

For travelers inside solar system, where need Pu in the driver formation, the Pu can be stored in the optimized target case be of / 0,01g and in the center 1μg of DT, or until solar system periphery are need by e ach fire in a second (can be need more) and by reactor or beam formation 279 / kg/year and 31,6 kg/year of DT, without take in count the fuel mass need in the exhaust, maintaining the fission mass and raising the fusion mass to gain better fission burn producing better energy to drive generation, since only 0,01g of mi cro fission produce 0,01 ton TNT, likewise 36MJ, 20 times more than energy / produced by 192 NIF laser and 1kg (more explosive version) to send in 5 years against an asteroid and likewise has specific impulse near z-pinch LMTL model from order of magnitude of the evaporated material is in the ten of kilogram, / and the velocity in this case is 30 km/s and 50% of fuel burn, and in the present invention with 1kg waste in the driver elaboration. With mini fission in a mod- el more light than W54 the velocity is less than 26km/s, or using mini fusion wi th an artifact called "baseball bomb" weighting 10 kg, initiated by plastic explo- sive lenses or with an model more light weighting 1kg if one day be possible ini

tiate fission with 1kg of chemical explosive. Then the ideal will be 10/50g of hi gh explosive micro lenses initiated by laser and detonate 10/50g of $P_U$/U since / the quantity of high explosive is equal to quantity of nuclear fuel to be detona-/ ted this relax the need for a fast and efficient coupling between the release of ex plosive energy and the fuel pellet, or the same with nuclear macroscopic detona tions, being the planetary travel rapidly viable. With 1g of Pu/U to beam forma-tion and 1g of DT or another nuclear fuel and 10% of fuel burn the velocity is / 258 km/s. The mass waste in the driver formation has to be less or equal to the / mass waste in the exhaust, or the mass in the velocity equation (1) is the sum of tree masses, since we fall in line 3 example of table 2 where the velocity is low. Supposing the same case but with 50% of fuel burn the velocity can be 573km/s and in the worst case 1% of fuel burn 82 km/s. The table 2, show that the values are the same for 1g, 5mg or 100mg, the change in velocity depend in burn per-/ cent in each case. Then with 10mg of $P_U$/U is above the cylinder mass and the / energy needed in the driver to initiate the reaction is near 100kJ. If the question is lowering mass then the ideal in the driver for propulsion by present method is the fuel mass near 0,001g of $P_U$/U that produce 7,4 MJ being need 10kJ of ener-gy in the driver and this driver how is less than 10MJ begin a DT reaction after DHe3 reaction, since a driver that initiate DHe3 combustion only, is out of cogi tation or scaling the present invention method. In cylindrical fuel case the target is made of shells in the reactor, and the fuel ray is the same size of ray spot dri-/ ver with or without tamper, pusher and magnetic field. The cylindrical geome-/ try is preferable to mount around the cylindrical target the capsule with the cyl-inders that will be evaporated by the target explosion, but is possible with sphe rical and conical fast ignition targets with direct and indirect drive and the laser cylinders that will made the laser launched separately from the targets.

This is an advantage, since will be possible to / model and test the system without wait 15 or 50 years.

Case not is possible obtain enough fuel by la- / boratory reactions in the ship, has to be an option between the fuels, where the / candidates will be DHe3 catalyzed reactions, having tritium, that lower fuel igni tion temperature, beyond the exhaust vessel need the protector shield or the opti on being by DT detonations that generating a progressive shock wave that will / arrive DHe3 cold fuel, from this macro nuclear fuel target, this model is adequa te for travelers inside solar system, where not need great storage fuel since it / can withdraw the production remaining the first wall, the protector shield (triti-/ um) and the magnetic field where this mass compensate the specific impulse, / since is into solar system, then the exhaust can support this high fuel temperatu- re 600 millions of Celsius degrees.

How the driver intensity is 10MJ for pure advan ced fuels, that is, without Uranium or DT, the intensity of the present driver is / related to micro explosions that will arrive the cylinder, will be modeled by be-/ fore method, using fission/fusion according to table 1.

The DT target mass in the micro fusion case is near 1/5μ through LTI target where the order of magnitude need in the driver is in the kJ less than 550kJ need by mini fission method to produce $2.10^9$J that is / enough to initiate DT reactions and arrive the cylinders generating beans in the/ 32/320MJ enough to initiate advanced fuels like $T_x$DHe3 and others advanced / with tritium or by fast ignition methods target and by direct or in direct driver.

The motor has magnetic field in the exhaust ves sel this make possible to rise the dimensions of the nuclear fuel target, since rais ing it the mass and consequently the density, lower the energy driver, using the/ lower temperature ignition (LTI) target in the experiments to energy production or with fast ignition methods in conical targets. The DT seed reactions are enou gh to initiate DHe3 reaction that is the cold fuel in the constitution of micro sph eres.

Like the drivers proposed in the present inventi- on are in the x radiation, the target constitution (spherical or cylindrical) in the / exhaust is plastic, DT and DHe3 or $T_x$DHe3.

The nuclear fuel target injection system in the / reactor in the case of micro fusion reactions is electrodynamics that is adequate to inject low mass target, and in fission/fusion micro reactions where the target has a capsule with two or more cylinders having therefore a reasonable mass, / by electromagnetic means, since inside the capsule have a very small quantity / of iron to facilitate the injection by electromagnetic accelerator where a slingsh ot capsule is accelerated and launch the target fuel. The accelerator capsule, levi tate like a superconductor train without to touch in the super conductor track, / that is braked and the target follow by inertia. The target tracking system is by / cameras and detectors like follow. In the exhaust with targets that can be illumi nated by direct and indirect drive the adequate means is by gas trigger where / the work gas is helium or another light gas this method avoid interaction with / exhaust magnetic field attaining the targets velocity of 500 m/s needing a gas re servoir and valve control, a cryostat that will store and load the target inside a / cylindrical tube of gas. From this point the target go by inertia where their traje ctory is traced by photodiodes or laser and cameras positioned belong cylindri-/ cal tube of gas contention and send information to a computer that calculate the distance and positioning from exhaust center, since in the same has cameras and photodiodes diametrical opposed sending signals and trace the tube by cameras. The target producer system by polymerization that make resistant polymer and permit automatic production is stored in a cryostat and this is connected to the system injection cryostat closing the cycle.

The exhaust vessel diameter is to support micro explosions between 1ton/800ton TNT that is between 3.5/35 meters.

Go to stars need motor using advanced fuels wi-

th maximum reduction in the shields and gun driver madding the fuel and the / driver by inertial fusion confinement.

No being possible to initiate or detonate at same time 50/100g of DHe3 or $T_x$DHe3 has to be used 4 reactors or space of confinament around the exhaust vessel detonating inside the exhaust 4 reactions or mo re in same time, or 4 semi hemispheres where each center has the same distance from the exhaust center with the advantage to scale the specific impulse since in each hemisphere center can be detonated many targets in a second.

Choosing the first wall material like Kevlar that is light and resistant, or carbon-carbon composite alloy that due to high melting point (1500°) give to the material high temperature resistance proposed to nucle ar rubbish container being the support structures of kevlar or steel and the magnetic field shield being of high temperature superconductors like mercury deri-/ vative and cupric oxide with variations in oxygen concentration when in some / cases add thallium or strontium obtaining metallic ceramics of high temperature superconductivity reducing the needs of immersion tanks having helium or ni-/ trogen refrigerated (in DHe3 what yet reduced in mass compensate this hypothe sis, beyond high specific impulse) or cooper derivatives and ceramics materials producing magnetic fields near 60T or more, or superconductivity binary alloy / of niobium that has the advantage to be transformed in thread and produce high magnetic field, or ambient superconductors where the candidate is He3 superflu idity will be the more light system with first wall refrigerator and magnetic field madding a test probe of low cost carrying the needs.

Simplifying: what is need is a nuclear fuel, we-/ re happen low intensity (scaling if need) nuclear fission/fusion reactions in a pla ce (reactor or reaction vessel) destined to made an energetic beam that by one's turn will initiate in the exhaust thermonuclear fusion micro reactions of fuels, / according with the finality of the motor near solar system periphery (DT, DT- /

DHe3, $T_xDHe3$) or beyond (DHe3, $T_xDHe3$, $T_xLi6$, DT-DHe3-DD) and the be am is directed to these fuels to initiate nuclear reactions and combustion and a magnetic field that will repel (expel) the hot plasma, and yet a mean of produce and inject the nuclear fuel, without enormous stored volume.

The invention will be better to understand with the following detailed description in consonance with annex figures.

FIGURE 1 represents one unit and a general mo tor vision with driver system.

FIGURE 2 represents one unit and a lateral mo-tor vision and the disposition of energetic beans around the exhaust vessel with/ hemispherical shape, in case of direct drive and corona formation with cylindri-cal and spherical target and show many processes.

FIGURE 3 represents one unit and a lateral mo-tor vision and the disposition of energetic beans with indirect and direct drive / with two side illumination, and the intensity of explosions the same than figure 2 for advanced fuels.

FIGURE 4 represents the same before situation but with explosions between 1 ton/2 ton TNT to make the x-ray or gamma-ray / laser beam with cylindrical contention vessel.

FIGURE 5 represents the same before situation, but with spherical vessel of contention.

FIGURE 6 represents the same before situation, but with in the 5 ton TNT or less and hemispherical vessel of contention, genera ting or not a primary exhaust and the beam for advanced fuels.

FIGURE 7 represents the capsule that contain / the target and the cylinder rod for x-ray laser generation.

FIGURE 8 represents the cylinder that will con tain micro explosions in many cases.

FIGURE 9 represents the set of coils that generate the magnetic field in the capsule that will collaborate to micro mini explosi-/ ons.

FIGURE 10 represents the reactor target in cyli ndrical shape to beam formation.

FIGURE 11 represents the reactor target in ellip soidal shape to beam formation.

FIGURE 12 represents the exhaust target in cyli ndrical shape.

FIGURE 13 represents the exhaust target in sph erical shape.

FIGURE 14 represents the reactor target and / their shields in cylindrical or spherical geometry.

FIGURE 15 represents the same before situati-/ on but with high micro magnetic field from capacitor banks or another processes.

FIGURE 16 represents the reactor target by fast gnition in cylindrical or spherical geometry.

FIGURE 17 represents the exhaust target injecti on system.

To agree with this figures and in your details / the present invention “PROPULSION MOTOR, PROCESSES AND BEANS / FROM THERMONUCLEAR FUSION MICRO REACTIONS” in conformity with figure 1, the motor is constituted from two rings (17), linked between it by sustentation bar (18) madding motor external structure (17,18) in the exhaust / (13,14,15), linked to an third ring (17A) and the mean driver reactor room (16) and in number of 4, in the optimized case that is by our turn are linked to (17). Where one or two lasers are operational and tree or two are maintained in reser

ve for possible repair. We can observe too the driver system (1) placed into mo tor external structure (17,18) and externally to exhaust (13,14, 15) that are illuminated by conventional laser or particles beans (2) and generate the energetic beam (8) directed to spherical target (10) inside the exhaust (13,14,15). How are 3 shields, and in the case of neutronic reactions, like DT, DTHe3, etc. In this case the micro explosions are between 0,02 to 0,1tonTNT producing in the be-/ am 32 MJ to 720 MJ with explosions diameter between 42cm do 1,97m corresponding to cylinder or spherical diameter (6) that will retain the micro explosi-/ ons like in figure 2, as well as the fuel target (3) contained in a capsule (5) where inside is the cylinder rod (4) for beam formation (8) that will be arrived by x-radiation from each micro explosion that is initiated by driver system (1). Made the energetic x-ray laser beam (8) by thermonuclear reactions, this will detonate the target fuel (10) inside the exhaust (13,14,15) where the line of force from magnetic field (12) is to avoid that the hot plasma touch the exhaust wall (13). This neutronic fuel (10) is injected by the production and injection system (19,/ 20) that can be placed in an extra room (16) such for fuel manufacturing (3,10) like inject it in the exhaust (13,14,15) like in the reactor (6A). In figure 3, the sa me before situation, but in this case the target (10) is cylindrical or spherical for fast ignition by direct drive, or by indirect drive with illumination by both sides (8), where the driver system (conventional laser or particles beans) (1) are pla-/ ced out of room (16) and inside the motor external structure (17,18) and direc-/ ted by mirrors (21) to the target (3) with the intention of advanced fuels detonation and with low tritium proportion or DTHe3 in target (10). In figure 4 wath / change from figure 3 is the system of micro explosions retention, need a cylin-/ der (6) with great diameter 3,5m since is to support greater detonations from 1 to 2 ton TNT. In figure 5 the change is the contention vessel shape that is sphe-/ rical (6) where the fuel (3) after detonation by any processes (laser, particles beans, z-pinch, MTF, anti-matter particles) will reach the cylinder (4) for beam /

formation that is vaporized when attained by x-rays from target detonation of / (3) that can be cylindrical spherical or ellipsoidal in fission case, that is micro / Centurion/Halite. In figure 6 what change is the intensity of detonation that can reach 5 ton TNT where the system of contention is changed by another vessel / in exhaust type that is the best way to disperse the micro explosion from (3) / that will arrive the cylinder rod (4) generating the energetic beam (8). In this ca se the vessel diameter is near 5,6m that with magnetic field (7) can be reduced / to 4m, or using an shock absorber where the fuel mass (3) if by micro fission ne ar 1 to 3 kg, and by micro fusion between 10μg/10mg of DT, in mini fission 10-g to 1kg of $P_u$/U (without chemical explosive mass or initiated by laser or micro mini explosive lenses initiated by laser) and in mini fusion like an artifact called "baseball bomb" with mass 10kg (the ideal is much less), generating in the be- / am 21 GJ that is enough to initiate any advanced fuel, helping to withdraw this / project from theory, although with values between 0,02 to 0,1g of $P_U$/U with de uterium in the center is an great improvement and to withdraw this project from theory, since the x-ray laser energy is from 7,2 MJ to 720MJ that has conditions to detonate $T_x$DHe3, with less ignition temperature than DHe3, needing the pro-tector shield (14) but less tick, since the present laser/particles beans made the / implosion or compression and moments before implosion to bring into action a/ magnetic field that avoid loss of fuel entropy like in figure 1 to 3, madding via-/ ble the present project. In this case to send an aerolite with much mass and velo city to repel an asteroid with much mass and breakable constitution and by fissi on explosions to make the beam with 1kg of $P_U$/U or less (10% of light W54 ex plosions), by mini fusion to make the beam explosions with the dimensions of / "baseball bomb", but I believe, agree with show the numbers, that micro fission fusion to make first the beam with the lowest mass quantities like in table 1 or / calculations above, will be possible without the need of extreme solutions, but feasible, or to model and demo the system. In figure 7 the capsule (5) used in /

the micro fission or micro fusion, when the beam (2) arrive the fuel (3), that af ter micro explosions, the x-rays from micro explosions arrive the cylinder (4) / that has in the extremity pointed to the target (10) an material (4A) transparent to x-radiation the same used in the cylinder or low Z material and in another ex tremity from cylinder (4) an material opaque to x-radiation (4B) or high Z mate rial madding this manner the lasing medium to nuclear micro bomb pumped x-ray laser, since is by fission or fusion. In figure 8 we see the capsule (3,4,5) bei ng arrived by the beans (2) that pass by orifice (6B) reaching the target (3) the / capsule (3,4, 5) is injected by orifice (6A) where the wall tick in this case is 10 cm of steel (6C) with a shell of lead in 20cm to retain the neutrons or carbon- / carbon composite (6D) for the neutrons not reach the coil (7) that will make the magnetic field. A particular case is when the energetic beam is only a hollow / particle beam (2) perpendicular to the target axis (3) having the configuration / of figure 15 and a axial magnetic field (7) that will act a little before implosion being subsequently of for the micro explosions arrive the cylinder (4) madding the laser like in figure 9 or the cylinder (4) are launched separately from target (3) by another orifice in (5) and (6). In figure 10 we has the target (10) in cylin drical shape used in the exhaust (13,14,15) being that (10A) is DT and (10B) is DHe3 or another neutron free fuel by direct drive with beam (8). Figure 11 re-/ presents the fuel (3) of ellipsoidal shape to make the beam (8) made from $P_U$/U (3A) e DT (3B), that is compressed in both sides by high explosives to sub cri-tical mass, like in figure 12 the fuel (3) from solid cylindrical shape containing $P_U$/U (3A) e DT (3B), and a normal beam. A particular case from cylindrical ge ometry is when adding a gold shell and is illuminated by pettawatt laser in both sides madding x-rays and a convergent cylindrical wave for compression. In fi gure 13 the target (10) used in the exhaust (13,14,15) constituted from plastic / (10D) aluminum, gold or tantalum (10C) and $DT_x$ (10A) like a micro explosion seed and (10B) that main fuel that can be DHe3, $T_x$DHe3, DHe3-DD, D-Li6.

In figure 14 we have the basic configuration / how design the target (3) of nuclear fuel in the reactor or vessel of contention / (6) for enhance the nuclear explosion and x-radiation after explosion. According to explosive lenses method the shell (3C) is relative to micro mini explo sive lenses (from mg to g of mass) initiated by laser or classical detonators ex ternal and around, and the shell (3D) is the tamper that in this case has double finality, like a compound of a explosive lenses that converts the diverging detonation wave in a converging shock wave, beyond to model in terms of radiation the explosion products like in W71 were use gold to enhance x-radiati-/ on and like a tamper, or thallium or tantalum to produce gamma radiation in / the 1200 MeV from nuclear micro explosion. The shell (3E) is relative to neu tron reflector may be beryllium or uranium and the shell (3A) the fissile mate rial and (3B) the DT to boost fission. A particular case is when the target (3) / is arrived by a pettawatt laser then the shell (3C) is gold when vaporized gene rate x-rays, the shell (3D) is the pusher being plastic or other low Z material / the other shells are the same in cylindrical or spherical geometry. In figure 15 the external shell of explosive lenses (3C) can be substituted by a z-pinch sys tem wire array z-pinch or MTF with the magnetic field (3C) obtained by su-/ perconductor of millimeter size, feed by an capacitor bank that is linked by / means of transmission lines (3F) to the target set (3A, 3E, 3D, 3C) or without some shells according each case. In figure 16 the basic target (3,10) configura tion for fusion fast ignition concept used as well as for fuel (3) in the reactor / (6) or for fuel (10) in the exhaust (13,14,15) in cylindrical or spherical geome tries by direct drive or indirect drive, being (3/10F) the gold cone for the ignitor in each case. In reactor (6) or vessel of contention the target (3) is bombarded by pettawatt laser (2A) or ignitor, and the external shell (3/10C) by laser or particles beans (2) for the compressor. In exhaust (13,14,15) the compressor / are laser and particles beans (2) and present invention beans (8) for fast igniti-/

on with the mean fuel (10), advanced fuels. By indirect drive because lasers / can be focused to heat very small spots, even relatively small lasers can achieve high temperatures in hohlraums. For this reason is normal cylindrical hohlhaums (3,10) with spherical target inside of the cylinder, is bombarded by both side with compressor beans (2) that deposit their energy in one side and the ig-/ nition beans (2A,8) deposit their energy by another side with the gold cone linked directly to target sphere inside the cylinder. Many other configurations can be possible. In figure 17 we have the injector system (19) from exhaust (13,14, 15) by gas trigger that is constituted from a gas reservoir (19A), control valve / (19B) to control pressure, temperature, etc inside the initial tube (19) and a cryostat (19C) to store the targets (10) that will be injected and come from produc tion system (20), needing then to remove the gas to an reservoir (19D) by means of suction bombs (19E) linked to reservoir (19D). The target (10) trajectory is traced by detectors or photodiodes or laser diodes (19F1 e 19F2) and camera system (19G) and to transmit for a computer that, calculate the target position.

To finalize, the injector system (19) for nuclear fuel (3) is by electromagnetic or electrodynamics means, since inside capsule(5) can be placed very small iron fragments to facilitate in the injection system (19) and positioning in the place were haven't the cylinder rod (4). The production system (20) of fuel (3) to reactor room (6) in case of micro fusion is by cryoge-/ nics and of fuel (10) is by polymerization and stored in a cryostat that is after linked in the injector system (19).

# CLAIMS

1) "PROPULSION MOTOR, PROCESSES AND BEANS FROM THERMO NUCLEAR FUSION MICRO REACTIONS" being the motor CHARACTERIZED by, to hold two cylindrical rings (17) that is fixed between it by cylindrical supports of sustentation (18), and a third cylindrical ring (17A) that will sustain the reactor room (16) of the mean drive (8) that is placed between the / two terminal rings, that by own turn are fixed to the cylindrical ring (17) that / sustain the exhaust wall (13) of shells (13,14,15) in hemispherical shape to pro tect the magnets (coils) (15) being the driver system (1) placed behind magnets (15) and inside reactor room (16).

2) "PROPULSION MOTOR", according claim 1, characterized by the driver / system (1) parallel placed to the vertical axis from exhaust (13,14,15) and the driver system (1) inside reactor room (16) substituted by mirrors (21) that will direct the beans (2) to arrive the target (3).

3) "PROPULSION MOTOR", according claim 1, characterized by the exhaust first wall (13) constituted from carbon-carbon composite and Kevlar.

4) "PROPULSION MOTOR", according claim 1, characterized by the exhaust first wall (13) constituted from carbon-carbon composite and graphite.

5) "PROPULSION MOTOR", according claim 1, characterized by the magnet (15) constituted of cooper and ceramic material.

6) "PROPULSION MOTOR", according claim 1, characterized by the super / conductor coils (15) constituted from $Nb_3Sn$.

7) "PROPULSION MOTOR", according claim 1, characterized by the super / conductor coils (15) constituted from $Nb_3Al$.

8) "PROPULSION MOTOR", according claim 1, characterized by the super conductor coils (15) constituted from $HgBa_2Ca_2Cu_3O_{8.33}$ with Ti and with vari ations of oxygen concentration.

9) "PROPULSION MOTOR", according claim 1, characterized by the exhaust (13,14,15) internal diameter able to support micro/mini explosions from 1 ton / to 800 ton TNT equivalent.

10) "PROCESSES AND BEANS FROM THERMONUCLEAR FUSION MICRO REACTIONS", according claim 1, characterized by hold a system of energetic beans (2) that cross a recipient (6), like a reactor, were arrive an target (3) of nuclear fuel madding nuclear micro reactions, arriving the inner capsule (5) containing cylinder rod (4) having in their extremity lenses (4A) transpa-/ rent to x-radiation, that will made the energetic beam (8) after arriving an tar-/ get (10) constituted from nuclear fuel producing fusion micro reactions (11), that generate very small charged particles that need a reflector magnetic field (12) in the external vessel, having a protector shield (14) to neutrons from each nuclear explosion, where the fuel (3,10) are injected by injector system (19) / and production system (20), beginning a new cycle.

11) "PROCESSES AND BEANS FROM THERMONUCLEAR FUSION MICRO REACTIONS", according claim (10), characterized by the energetic be-/ am (2) constituted from photons.

12) "PROCESSES AND BEANS FROM THERMONUCLEAR FUSION MICRO REACTIONS", according claim (10), characterized by the energetic be-/ am (2) constituted from particles of light elements of periodic table.

13) "PROCESSES AND BEANS FROM THERMONUCLEAR FUSION MICRO REACTIONS", according claim (10), characterized by the energetic be-/ am (2) constituted from heavy elements of periodic table.

14) "PROCESSES AND BEANS FROM THERMONUCLEAR FUSION MICRO REACTIONS", according claim (10), characterized by the energetic be-/ am (2) constituted from neutrons and anti particles produced by laser.

15) "PROCESSES AND BEANS FROM THERMONUCLEAR FUSION MI-

CRO REACTIONS", according claim (10), characterized by the reactor vessel (6) of cylindrical shape with holes (6A) to channel the beam (2) arriving the ta rget (3) of nuclear fuel, with help of coils (7) constituted from NbTi.

16) "PROCESSES AND BEANS FROM THERMONUCLEAR FUSION MI-CRO REACTIONS", according claim (10), characterized by the reactor vessel (6) of cylindrical shape with holes (6A) to channel the beam (2) arriving the ta rget (3) from nuclear fuel with the help of coils (7) constituted from cooper, al uminum and silver.

17) "PROCESSES AND BEANS FROM THERMONUCLEAR FUSION MI-CRO REACTIONS", according claim (10), characterized by the reactor vessel (6) of cylindrical shape with holes (6A) to channel the beam (2) arriving the ta rget (3) from nuclear fuel with the help of coils (7) constituted from cooper al uminum and niobium.

18) "PROCESSES AND BEANS FROM THERMONUCLEAR FUSION MI-CRO REACTIONS", according claim (10, characterized by the reactor vessel (6) of spherical shape with holes (6A) to channel the beam (2) arriving the ta rget (3) from nuclear fuel madding the energetic beam (8) arriving the target / (10) of nuclear fuel.

19) "PROCESSES AND BEANS FROM THERMONUCLEAR FUSION MI-CRO REACTIONS", according claim (10), characterized by the reactor vessel (6) of hemispherical shape with holes (6A) to channel the beam (2) arriving / the target (3) from nuclear fuel madding the energetic beam (8) arriving the tar get (10) of nuclear fuel across hole (6B).

20) "PROCESSES AND BEANS FROM THERMONUCLEAR FUSION MI-CRO REACTIONS", according claim (10), characterized by the reactor vessel (6) has a shield of steel 10cm/20cm of tick (6C) and lead (6D) to protect the / magnets (7) and magnets (15).

21) "PROCESSES AND BEANS FROM THERMONUCLEAR FUSION MICRO REACTIONS", according claim (10), characterized by the reactor vessel (6) has a shield of steel 10cm/20cm of tick (6C) and carbon-carbon composite (6D) to protect the magnets (7) and magnets (15).

22) "PROCESSES AND BEANS FROM THERMONUCLEAR FUSION MICRO REACTIONS", according claim (10), characterized by the cylindrical ca psule (5) containing inner cylinder rod (4) of millimeter dimension constituted from aluminum and lenses (4A) of light Z elements.

23) "PROCESSES AND BEANS FROM THERMONUCLEAR FUSION MICRO REACTIONS", according claim (10), characterized by the cylindrical ca psule (5) containing inner cylinder rod (4) of millimeter dimension constituted from tungsten and lenses (4A) of light Z elements.

24) "PROCESSES AND BEANS FROM THERMONUCLEAR FUSION MICRO REACTIONS", according claim (10), characterized by the cylindrical ca psule (5) containing inner cylinder rod (4) of millimeter dimension constituted from gold and lenses (4A) of light Z elements.

25) "PROCESSES AND BEANS FROM THERMONUCLEAR FUSION MICRO REACTIONS", according claim (10), characterized by inside spherical / reactor vessel (6) cylinder rod (4) separately from target (3) of millimeter dimmension constituted from aluminum and lenses (4A) of light Z elements.

26) "PROCESSES AND BEANS FROM THERMONUCLEAR FUSION MICRO REACTIONS", according claim (10), characterized by inside spherical / reactor vessel (6) cylinder rod (4) separately from target (3) of millimeter dimensions constituted from tungsten and lenses (4A) of light Z elements.

27) "PROCESSES AND BEANS FROM THERMONUCLEAR FUSION MICRO REACTIONS", according claim (10), characterized by inside spherical / reactor vessel (6) cylinder rod (4) separately from target (3) of millimeter dim-

ensions constituted from gold and lenses (4A) of light Z elements.

28) "PROCESSES AND BEANS FROM THERMONUCLEAR FUSION MICRO REACTIONS", according claim (10), characterized by inside hemispherical reactor vessel (6) has cylinder rod (4) separately from target (3) of millimeter dimensions constituted from aluminum and lenses (4A) of light Z elements.

29) "PROCESSES AND BEANS FROM THERMONUCLEAR FUSION MICRO REACTIONS", according claim (10), characterized by inside hemispherical reactor vessel (6) has cylinder rod (4) separately from target (3) of millimeter dimensions constituted from tungsten and lenses (4A) of light Z elements.

30) "PROCESSES AND BEANS FROM THERMONUCLEAR FUSION MICRO REACTIONS", according claim (10), characterized by inside hemispherical reactor vessel (6) has cylinder rod (4) separately from target (3) of millimeter dimensions constituted from gold and lenses (4A) of light Z elements.

31) "PROCESSES AND BEANS FROM THERMONUCLEAR FUSION MICRO REACTIONS", according claim (10), characterized by the target (3) has the cylindrical shape and constituted of uranium/plutonium from 0,001g to 0,1 g and μg of DT in the center of cylinder (3) happening fission and fusion mi-/cro explosions from 0,01 to 0,1 ton TNT equivalent contained in cylindrical reactor vessel (6) from 42cm to 1,90m in inner diameter.

32) "PROCESSES AND BEANS FROM THERMONUCLEAR FUSION MICRO REACTIONS", according claim (10), characterized by the target (3) has the cylindrical shape and constituted of uranium/plutonium from 1g/2g and μg of DT in the center of cylinder (3) happening fission and fusion micro explosions from 1 ton to 2 ton TNT contained in a cylindrical reactor vessel (6) from 3,5m to 4,5m in inner diameter.

33) "PROCESSES AND BEANS FROM THERMONUCLEAR FUSION MICRO REACTIONS", according claim (10), characterized by the target (3) of /

spherical shape constituted of uranium/plutonium from 0,001g to 0,1g and µg of DT in the center of sphere (3) happening fission and fusion micro explosi-/ ons from 0,01 to 0,1 ton TNT contained in spherical reactor vessel from 49cm to 1,90m in inner diameter.

34) "PROCESSES AND BEANS FROM THERMONUCLEAR FUSION MI-CRO REACTIONS", according claim (10), characterized by the target (3) of / spherical shape constituted of uranium/plutonium from 1g to 2g and µg of DT in the center of sphere (3) happening fission and fusion micro explosions from 1 ton to 2 ton TNT contained in a spherical reactor vessel (6) from 3,5m to 4,5 m in inner diameter.

35) "PROCESSES AND BEANS FROM THERMONUCLEAR FUSION MI-CRO REACTIONS", according claim (10), characterized by the target (3) of spherical shape constituted of uranium/plutonium from 3g to 5g and µg of DT in the center of sphere (3) happening fission and fusion micro explosions from 3 ton to 5 ton TNT contained in a hemispherical reactor vessel (6) from 5,0m / to 7,0m in inner diameter.

36) "PROCESSES AND BEANS FROM THERMONUCLEAR FUSION MI-CRO REACTIONS", according claim (10), characterized by the target (3) of ellipsoidal shape and constituted of uranium/plutonium from 0,001g to 0,1g / and µg of DT in the center of ellipsoid (3) contained in a cylindrical/spherical reactor vessel (6) from 49cm to 1,90m in inner diameter.

37) "PROCESSES AND BEANS FROM THERMONUCLEAR FUSION MI-CRO REACTIONS", according claim (10), characterized by the target (3) of / ellipsoidal shape and constituted of uranium from 1kg of uranium/plutonium / and µg of DT in the center of ellipsoid (3) happening fission and fusion micro / explosions contained in a spherical/hemispherical reactor vessel (6).

38) "PROCESSES AND BEANS FROM THERMONUCLEAR FUSION MI-

CRO REACTIONS", according claim (10), characterized by the target (3) of / cylindrical/spherical/ellipsoidal/ shape from 0,001g to 1kg of uranium/plutonium and µg of DT in the center of target (3) happening fission and fusion micro explosions initiated by energetic beans (2) (laser/particles).

39) "PROCESSES AND BEANS FROM THERMONUCLEAR FUSION MICRO REACTIONS", according claim (10), characterized by the target (3) of / cylindrical/spherical/ellipsoidal shape from 0,001g to 1kg of uranium/plutonium and µg of DT in the center of target (3) happening fission and fusion micro explosions initiated by chemical high explosives.

40) "PROCESSES AND BEANS FROM THERMONUCLEAR FUSION MICRO REACTIONS", according claim (10), characterized by the target (3) of / cylindrical/spherical/ellipsoidal shape from 0,001g to 1kg of uranium/plutoni-/ um and µg of DT in the center of target (3) happening fission and fusion micro explosions initiated by micro/mini explosives lenses initiated by lasers.

41) "PROCESSES AND BEANS FROM THERMONUCLEAR FUSION MICRO REACTIONS", according claim (10), characterized by the target (3) in / cylindrical/spherical shape and constituted from µg to mg of DT happening mi cro/mini nuclear fusion explosions initiated by energetic beans (2) (laser/particles).

42) "PROCESSES AND BEANS FROM THERMONUCLEAR FUSION MICRO REACTIONS", according claim (10), characterized by the target (3) in / cylindrical/spherical shape and constituted from µg to mg of DT happening mi cro/mini nuclear fusion explosions initiated by high chemical explosive, MTF, wire array z-pinch, fast z-pinch with magnetic field of, after nuclear explosions.

43) "PROCESSES AND BEANS FROM THERMONUCLEAR FUSION MICRO REACTIONS", according claim (10), characterized by the target (3) in /

cylindrical/spherical geometry having the shells (3C) of high explosive micro/ mini lenses initiated by lasers, the tamper shell (3D), the neutron reflector shell (3E), the fission shell (3A) and the fusion shell (3B) with variations in shells / constitution, according with driver (2) applied z-pinch, fast z-pinch, array z-pinch, MTF, beam of anti particles from CPA laser impact against heavy elemen ts.

44) "PROCESSES AND BEANS FROM THERMONUCLEAR FUSION MICRO REACTIONS", according claim (10), characterized by in the target (3) / the tamper shell (3D) constituted from gold in micro fission explosions and the others shells the same.

45) "PROCESSES AND BEANS FROM THERMONUCLEAR FUSION MICRO REACTIONS", according claim (10), characterized by in the target (3) / the tamper shell (3D) constituted from tantalum in micro fission explosions / and the others shells the same.

46) "PROCESSES AND BEANS FROM THERMONUCLEAR FUSION MICRO REACTIONS", according claim (10), characterized by the targets (3,10) constituted from shells (3/10A, 3/10B, 3/10C, 3/10D, 3/10E) to fast ignition / geometry with gold cone (3/10F) linked to the shell (3B) arrived by the ignitor beans (2A) in reactor vessel (6) and energetic beans (8) in the exhaust vessel / (13,14,15).

47) "PROCESSES AND BEANS FROM THERMONUCLEAR FUSION MICRO REACTIONS", according claim (10), characterized by the beam (8) con stituted from x-ray laser pumped by micro/mini fission/fusion explosions.

48) "PROCESSES AND BEANS FROM THERMONUCLEAR FUSION MICRO REACTIONS", according claim (10), characterized by the beam (8) con stituted from $\gamma$-ray laser pumped by micro/mini fission/fusion explosions.

49) "PEOCESSES AND BEANS FROM THERMONUCLEAR FUSION MI-

CRO REACTIONS", according claim (10), characterized by the target (10) with cylindrical/spherical geometry constituted of μg of plastic foam (10D), μg/mg of gold (10C), μg/mg of DT (10A) and the mean fuel (10B) with μg/mg of DHe3/$T_x$DHe3.

50) "PROCESSES AND BEANS FROM THERMONUCLAER FUSION MICRO REACTIONS", according claim (10), characterized by the protector shield (14) constituted from steel and carbon-carbon composite.

51) "PROCESSES AND BEANS FROM THERMONUCLEAR FUSION MICRO REACTIONS", according claim (10), characterized by the protector shield (14) constituted from Kevlar and graphite.

52) "PROCESSES AND BEANS FROM THERMONUCLEAR FUSION MICRO REACTIONS", according claim (10), characterized by the injector sys-/tem (19) in the reactor vessel (6) by electromagnetic means.

53) "PROCESSES AND BEANS FROM THERMONUCLEAR FUSION MICRO REACTIONS", according claim (10), characterized by the injector sys-/tem (19) in the reactor vessel (6) by electrodynamics means.

54) "PROCESSES AND BEANS FROM THERMONUCLEAR FUSION MICRO REACTIONS", according claim (10), characterized by the injector sys-/tem (19) in the exhaust (13,14,15) constituted by gas trigger (19A), a control / valve (19B), an criostate (19C), a system of gas remove (19D), suction pumps (19E) and light detectors (19F1 e 19F2) and cameras (19G).

55) "PROCESSES AND BEANS FROM THERMONUCLEAR FUSION MICRO REACTIONS", according claim (10), characterized by the production system (20) from fuel (3,10) by cryogenic and polymerization.

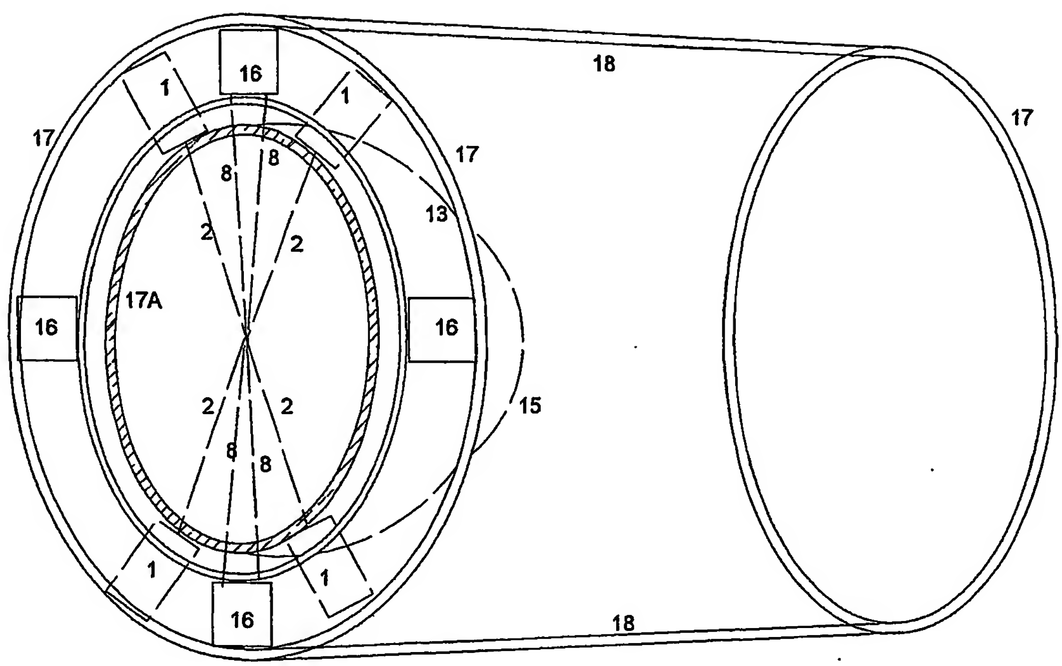


FIGURA 1

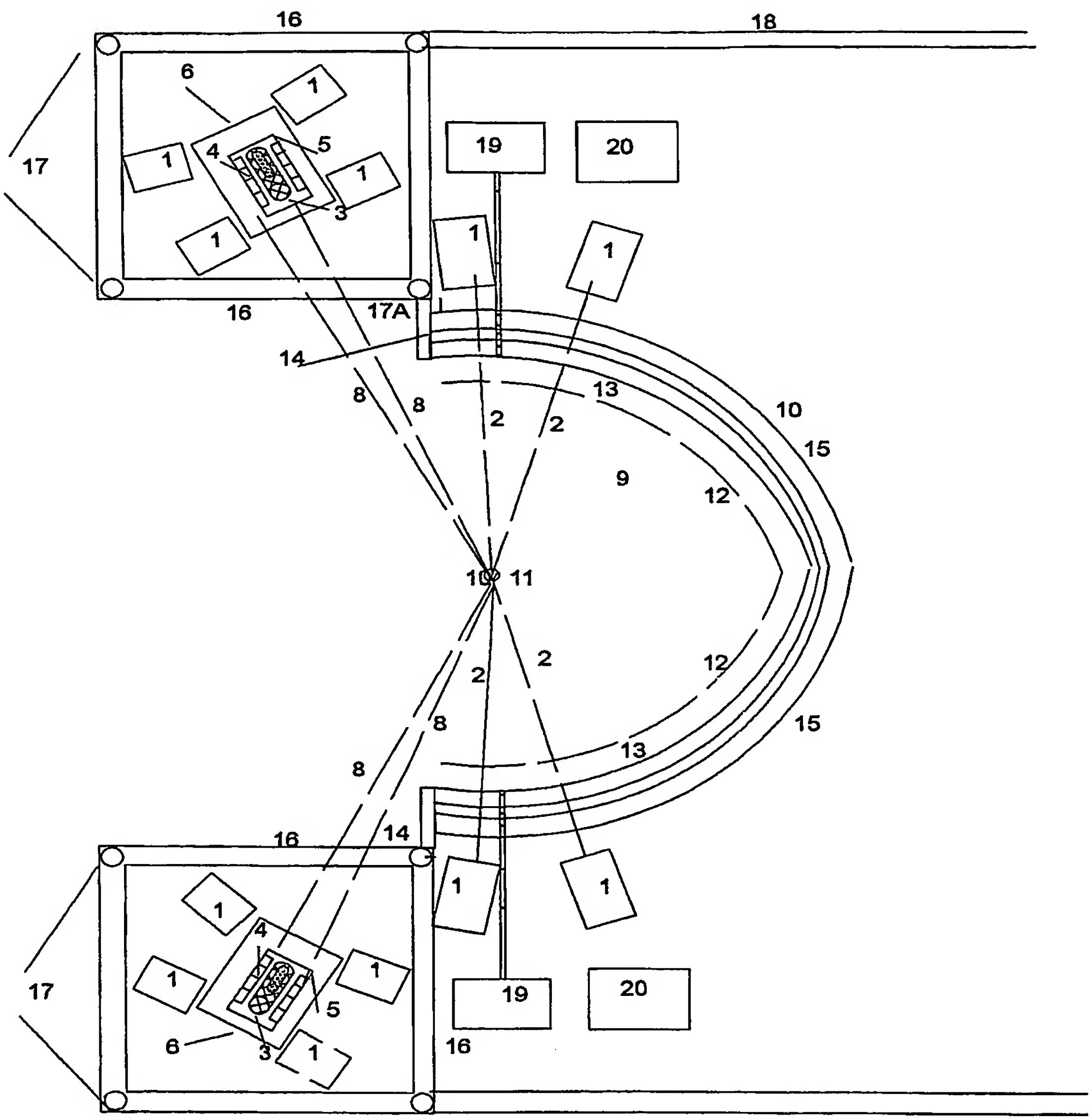
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FIGURA 2

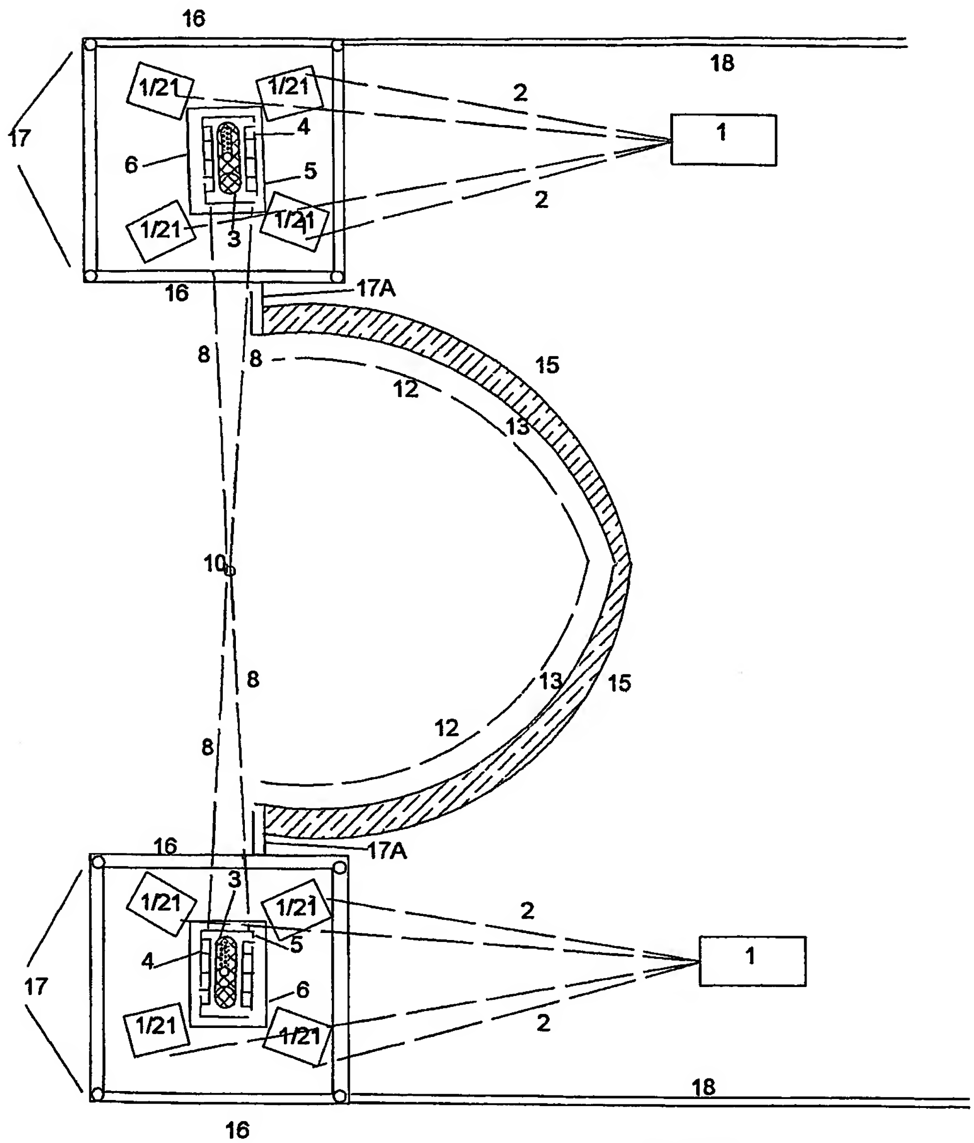
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FIGURA 3

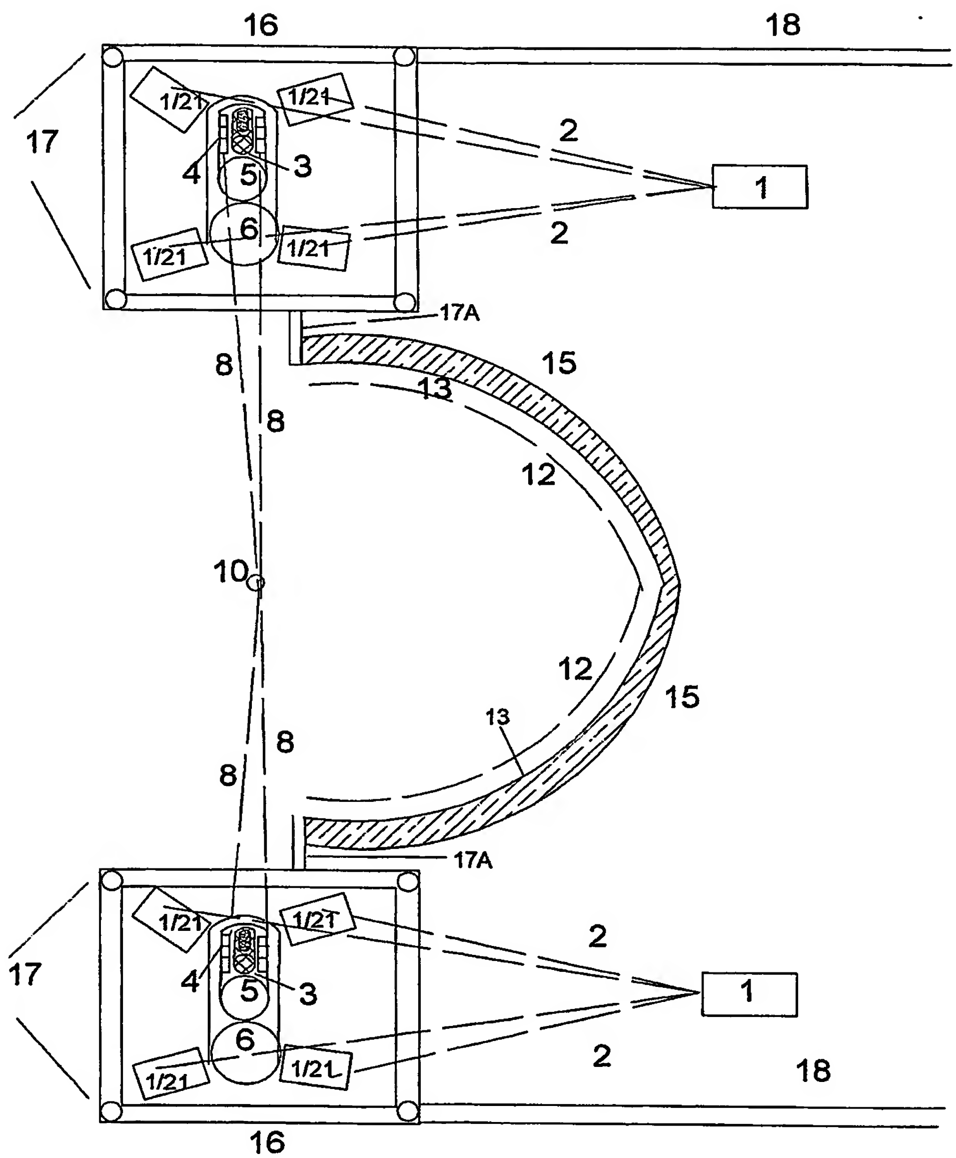
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FIGURA 4

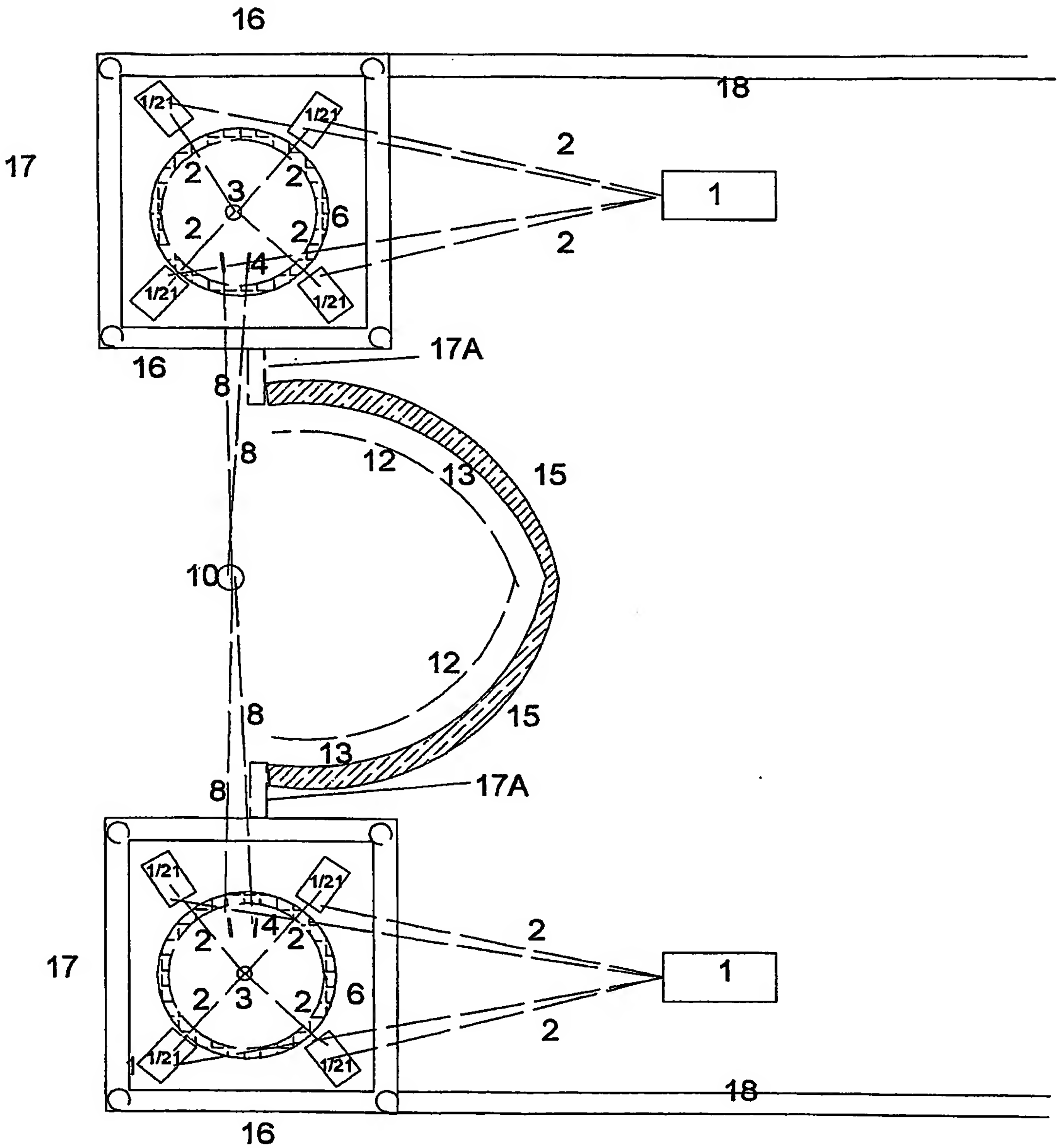
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FIGURA 5

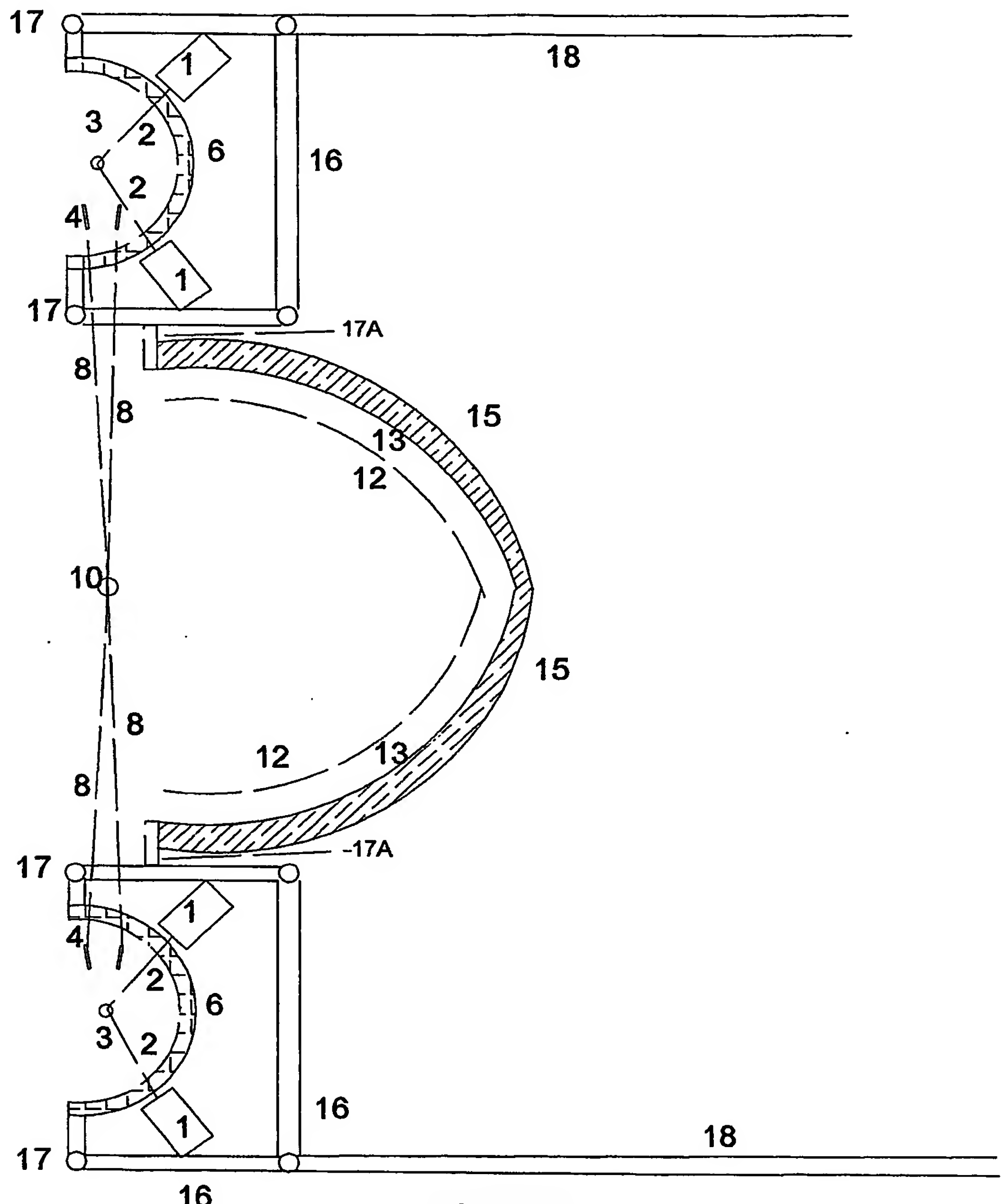
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FIGURA 6

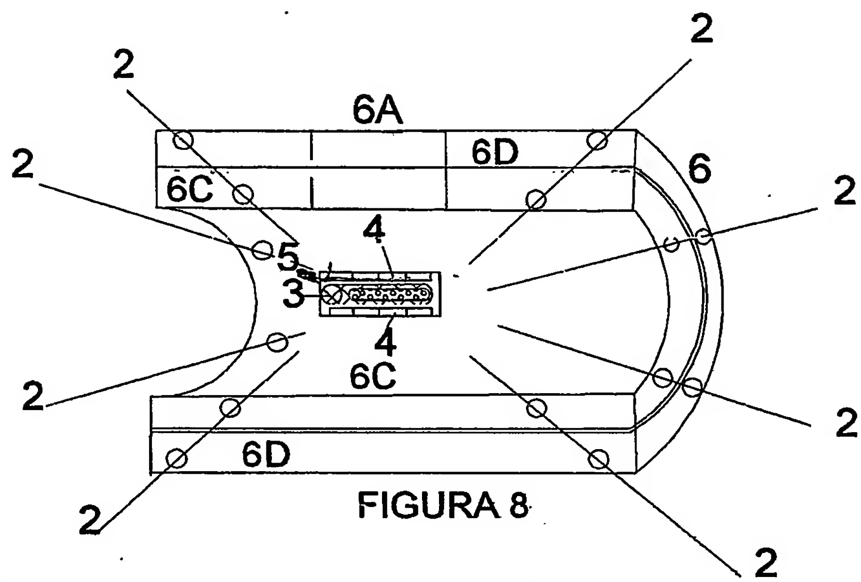


FIGURA 8

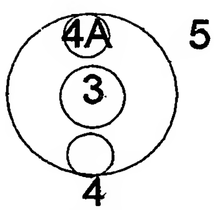


FIGURA 7

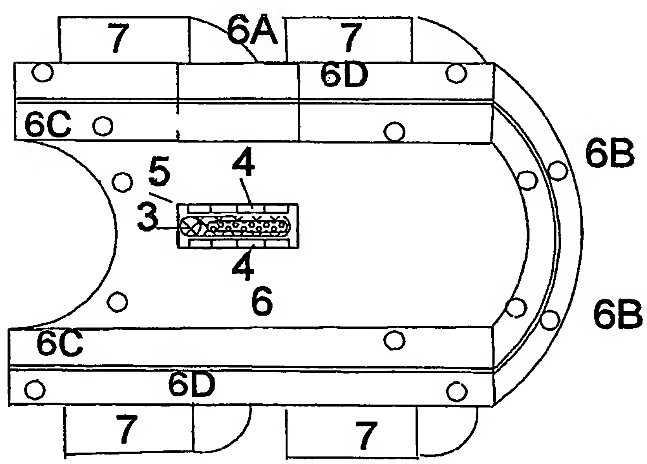


FIGURA 9

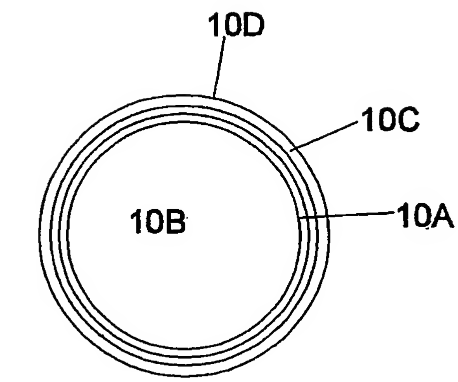


FIGURA13

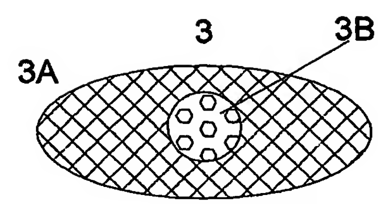


FIGURA 11

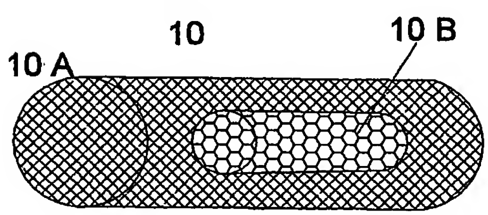


FIGURA 10

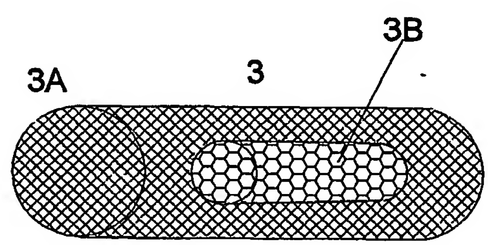


FIGURA 12

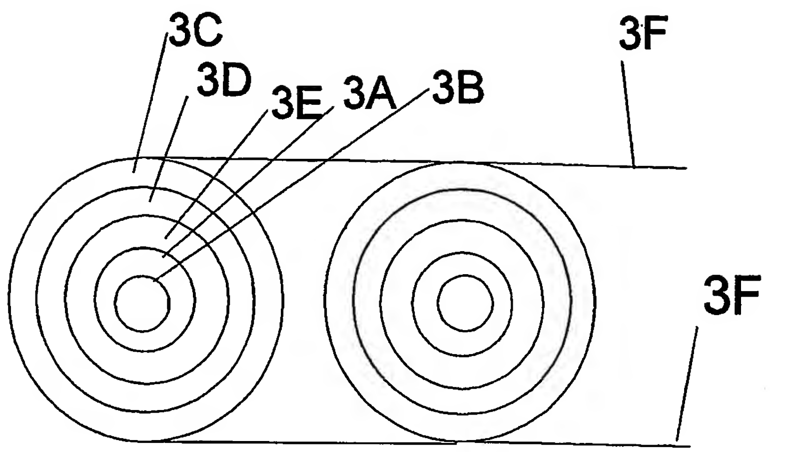


FIGURE 15

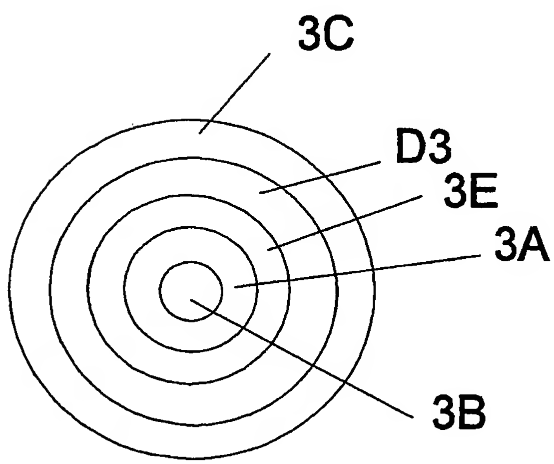


FIGURE 14

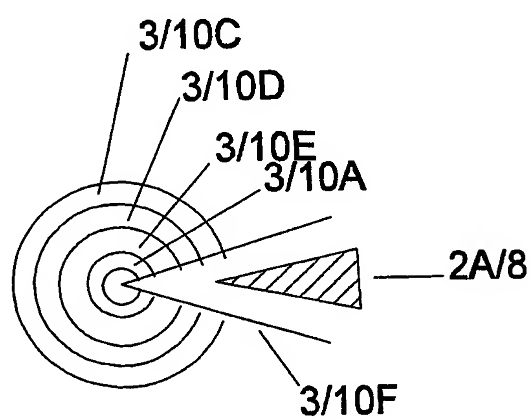


FIGURE 16

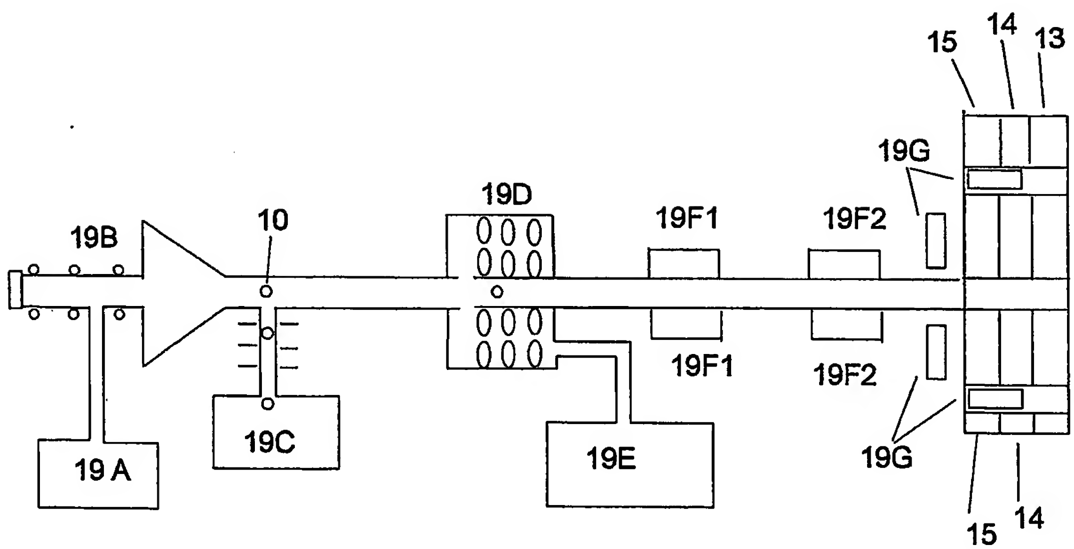


FIGURE 17

# INTERNATIONAL SEARCH REPORT

International application No.
PCT/BR 03/00046-0

CLASSIFICATION OF SUBJECT MATTER

IPC$^7$: F03H 1/00

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC$^7$: F03H 1/00

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

| Category | Citation of document, with indication, where appropriate, of the relevant passages | Relevant to claim No. |
|---|---|---|
| A | US 3336749 A (ROM ET AL) 22 August 1967 (22.08.67) *the whole document.* ---- | 1 |

☐ Further documents are listed in the continuation of Box C. ☒ See patent family annex.

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„E" earlier application or patent but published on or after the international filing date
„L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
„O" document referring to an oral disclosure, use, exhibition or other means
„P" document published prior to the international filing date but later than the priority date claimed
„T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
„X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
„Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
„&" document member of the same patent family

| Date of the actual completion of the international search | Date of mailing of the international search report |
|---|---|
| 10 September 2003 (10.09.2003) | 21 October 2003 (21.10.2003) |


| Name and mailing adress of the ISA/AT | Authorized officer |
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| Austrian Patent Office<br>Dresdner Straße 87, A-1200 Vienna<br>Facsimile No. 1/53424/535 | PIPPAN P.<br>Telephone No. 1/53424/359 |

# INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.
PCT/BR 03/00046-0

| Patent document cited in search report | Publication date | Patent family member(s) | Publication date |
|---|---|---|---|
| US A 3336749 | | none | |